CLAIMS

WHAT IS CLAIMED IS:

1. A micro-switch comprising:

a plurality of substrates bonded together to form a hermetic cavity, the hermetic cavity sealed by at least one seal ring including at least one layer of metal;

at least two signal paths that run from inside the cavity to outside the cavity; and

at least one movable structure within said cavity, wherein the movable structure is moved in response to a force provided by an actuator.

2. The micro-switch of claim 1, wherein at least two signal paths is electrically connected to each other.

3. The micro-switch of claim 1, wherein said movable structure is selected from a list of movable structures consisting of: a cantilever, a see-saw structure, a cantilever with more than one pedestal and a membrane.

4. The micro-switch of claim 1, wherein said force is provided from an actuator selected from a list of actuators consisting of: electrostatic, electromagnetic, thermal, electro-thermal, and shape-memory alloy.

5. The micro-switch of claim 1, wherein electrical contact is selected from a list of electrical contacts consisting of: metal contact, capacitive, and shunt.

6. The micro-switch of claim 1, wherein said two substrates are bonded together with a gold thermocompression bonding process.

7. The micro-switch of claim 6, wherein said gold thermocompression bonding process is performed below 300 degrees C during bonding.

8. The micro-switch of claim 6, wherein said gold thermocompression bonding process is performed without heating said substrates during bonding.

9. The micro-switch of claim 1, wherein said seal ring is least 5 microns wide.

10. The micro-switch of claim 1, wherein said seal ring is at least 20 microns wide.

11. The micro-switch of claim 1, wherein said seal ring comprises metal layers deposited on the two substrates.

12. The micro-switch of claim 11, wherein metal layers of at least one substrate include gold before bonding as a surface layer.

13. The micro-switch of claim 11, wherein metal layers of at least one substrate include a metal with little or no surface oxide before bonding as a surface layer.

14. The micro-switch of claim 11, wherein metal layers of at least one substrate include a deformable metal as a surface layer before bonding.

15. The micro-switch of claim 14, wherein said deformable metal includes gold and at least one barrier layer.

16. The micro-switch of claim 1, wherein said substrates are wafers, and more than one micro-switch is formed when said two substrates are bonded.

17. The micro-switch of claim 1, wherein at least one substrate includes a mechanical stop for bonding.

18. The micro-switch of claim 1, wherein said movable structure is fabricated out of a material selected from a list of materials consisting of: silicon, polysilicon, gold, silicon nitride, silicon oxynitride, nickel, silicon oxide and aluminum.

19. A lid assembly for a micro-switch comprising:

a substrate;

a first insulating layer formed on the substrate;

a first conductive layer formed on the substrate;

at least two signal paths formed in the conductive layer;

a second insulating layer formed on the first conductive layer;

an insulating ring formed in the second insulating layer;

a second conductive layer formed on the second insulating layer;

a first conductive ring formed in the second conductive layer, the first conductive ring substantially aligned with and overlying the insulating ring;

a second substrate having a second conductive ring at least partially surrounding a movable structure, the second conductive ring on the second conductive layer substantially aligned with and overlying the first conductive ring around the movable structure, thereby forming a seal around the movable structure when the lid assembly is bonded to the second substrate;

at least two external signal contact points formed in the first conductive layer, each contact point electrically connected to at least one of the signal paths, and each contact point outside the seal around the movable structure;

an actuator formed in the first conductive layer for providing a force on a movable structure on the second substrate; and

at least one signal path formed in the first conductive layer electrically connected to the actuator.

20. A method of making a lid assembly for a micro-switch, the method comprising:

forming a first insulating layer on a first substrate;

forming a first conductive layer on the first substrate;

forming at least two signal paths in the first conductive layer;

forming at least two external signal contact points in the first conductive layer, each electrically connected to at least one of the signal paths;

forming an actuator in the first conductive layer for providing a force on a movable structure on a second substrate;

forming at least one signal path in the first conductive layer electrically connected to the actuator;

forming a second insulating layer on the first conductive layer;

forming an insulating ring in the second insulating layer;

forming a second conductive layer on the second insulating layer;

forming a first conductive ring around a movable structure on a second substrate;

forming a second conductive ring in the second conductive layer, the second conductive ring in the second conductive layer substantially aligned with and overlying the insulating ring, the second conductive ring in the second conductive layer also substantially aligned with and overlying the first conductive ring around a moving structure on the second substrate; and

bonding the first and second substrates together forming a sealed cavity and thereby sealing the movable structure, wherein the at least two signal paths run from inside the cavity to outside the cavity, and each of the signal paths that run from inside to outside the cavity is connected to an external signal contact point outside the cavity.